angle of the reproducing light by an amount greater than a difference between a polarization angle of the recording light used to form the optical element and a polarization angle of the reproducing light before the reproducing light is acted on by the optical element; and

a substrate which sustains the optical recording layer,

wherein the reproducing light is directed onto the optical recording medium after the azimuth of birefringence of the optical element has been multilevel-modulated so that recorded information can be reproduced.

REMARKS

Claims 1-55 are pending. By this Amendment, claims 1, 11, 21, 22, 26, 30, 35, 37, 39, 40, 43, 46, 49 and 52-55. Reconsideration in view of the above amendments and following remarks is respectfully requested.

The attached Appendix includes marked-up copies of each rewritten claim (37 C.F.R. §1.121(c)(1)(ii)).

Applicants gratefully appreciate the courtesy extended to Applicants' attorney during the September 5 personal interview with Examiner Chu. The points discussed during the personal interview are reemphasized in this Amendment.

The Office Action rejects claims 1-29 and 35-55 under 35 U.S.C. §103(a) as being unpatentable over Leube (U.S. Patent No. 5,251,197) in view of Lindow (U.S. Patent No. 4,847,823) and Michl (U.S. Patent No. 4,864,537); and claims 30-24 are rejected under 35 U.S.C.§102 (b) as being anticipated by Lindow. Applicants respectfully traverse the rejections.

In particular, Applicants assert that neither Leube, Lindow or Michl, either alone or in combination, disclose or suggest an optical recording medium, including at least one optical recording layer, the optical recording layer including an optical recording material that changes a state of photo-induced birefringence in response to a recording light, a portion of

the recording layer that changes a stage of photo-induced birefringence substantially acting optically as a half-wave plate, wherein an azimuth of the half-wave plate within the optical recording medium is multilevel-modulated so that information is recorded on the optical recording medium by the recording light, as recited in independent claim 1, and similarly recited in independent claims 11, 21, 22, 26, 35, 37, 39, 40, 43, 46, 49 and 52-55.

Furthermore, neither Leube, Lindow or Michl, either alone or in combination, disclose or suggest an optical recording apparatus, including at least a focusing optical system that multilevel-modulates an azimuth of an optical recording layer within an optical recording medium by directing the recording light obtain through a special optical modulator to the optical recording medium, as recited in independent claim 30.

Specifically, Leube discloses that after birefringence was induced in a film 12 by irradiating the film 12 with light from an argon laser 14 through a shutter 24, the laser 14 was rotated 90° degrees so that the incident light beam was linearly polarized in the direction indicated at reference number 30. See Fig. 1, and column 8, lines 15-68. Rotation of the linearly polarized light beam could likewise be accomplished by using a half-wave plate or similar device if so desired. However, when irradiated with light from the same laser whose polarization had been rotated 90° degrees, the induced birefringence along the direction indicated by arrow 22 was erased.

Lindow discloses a scanning confocols optical imaging system is utilized to read or measure data magnetically recorded on a magneto-optical disk.

Michl discloses a polymer and dye combination suitable for use in optically recorded information.

In stark contrast to Applicants' claimed invention, neither Leube, Lindow or Michl, either alone or in combination, disclose or suggest an optical recording medium, wherein at least an azimuth of a half-wave plate within an optical recording medium is

multilevel-modulated so that information is recorded on the optical recording medium by the recording light. Furthermore, neither Leube, Lindow or Michl disclose or suggest an optical recording apparatus including at least a focusing optical system that multilevel-modulates an azimuth of an optical recording layer within an optical recording medium by directing a recording light obtained through a spatial modulator obtained through a spatial optical modulator to the optical recording medium.

On the contrary, the Examiner agreed during the personal interview that a combination of the applied references fail to disclose multi-modulating and recording by a recording light an azimuth of an optical element, i.e., a half-wave plate or a quarter-wave plate, within an optical recording medium to record and reproduce information. Accordingly, because the applied references fails to disclose these features, Applicants assert that it would not have been obvious to combine the applied references to arrive at the claimed invention.

Thus, Applicants assert that independent claims 1-55 define patentable subject matter. Accordingly, Applicants respectfully request that the rejections under 35 U.S.C. §102(b) and 35 U.S.C. §103(a) be withdrawn.

In view of the foregoing amendments and remarks, Applicants submit that this application is in condition for allowance. Favorable reconsideration and prompt allowance of claims 1 - 55 are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this application in better condition for allowance, the Examiner is invited to contact Applicants' undersigned attorney at the telephone number set forth below.

Respectfully submitted,

James A. Oliff
Registration No. 27,075

Richard S. Elias
Registration No. 48,806

JAO:RSE/alp

Attachment:
Appendix

Date: September 12, 2002

OLIFF & BERRIDGE, PLC
P.O. Box 19928
Alexandria, Virginia 22320
Telephone: (703) 836-6400

DEPOSIT ACCOUNT USE AUTHORIZATION
Please grant any extension necessary for entry;
Charge any fee due to our Deposit Account No. 15-0461

APPENDIX

Changes to Claims:

The following is a marked-up version of the amended claims:

1. (~~Four~~ Five Times-Amended) An optical recording medium, comprising at least one optical recording layer, the optical recording layer including an optical recording material having at least one of a polymer or a liquid crystal polymer that changes a state of photo-induced birefringence in response to a recording light that is externally controlled from the optical recording medium to rotate a polarization angle of the recording light, a portion of the recording layer that changes a state of photo-induced birefringence substantially acting optically as a half-wave plate; and

a substrate which sustains the optical recording layer,

wherein an azimuth of the half-wave plate within the optical recording medium is multilevel-modulated so that information is recorded on the optical recording medium by the recording light~~recorded information can be reproduced from so that the polarization angle of a reproducing light is at least twice that of the recording light~~.

11. (~~Three~~ Four Times-Amended) An optical recording medium comprising:

at least one optical recording layer including an optical recording material that changes a state of photo-induced birefringence in response to a recording light that is externally controlled from the optical recording medium to rotate a polarization angle of the recording light, a portion of the recording layer that changes a state of photo-induced birefringence substantially acting optically as a quarter-wave plate; and

an optical reflection layer formed on one surface of said optical recording layer,

wherein an azimuth of the quarter-wave plate within the optical recording medium is multilevel-modulated so that information is recorded on the optical recording

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medium by the recording light.~~wherein recorded information can be reproduced from the optical recording medium so that the polarization angle of a reproducing light is at least twice that of the recording light.~~

21. (~~Four~~ Five Times-Amended) An optical recording medium, comprising an optical recording layer that includes a material having at least one of a polymer or a liquid crystal polymer in which an azimuth of birefringence that is induced by a recording light externally controlled from the optical recording medium to rotate a polarization angle of the recording light changes in response to a rotation of the polarization angle of said recording light; and

a substrate which sustains the optical recording layer,

wherein an azimuth of the optical recording layer is multilevel-modulated so that information is recorded on the optical recording medium by the recording light.~~wherein recorded information can be reproduced from the optical recording medium so that the polarization angle of a reproducing light is at least twice that of the recording light.~~

22. (~~Three~~ Four Times-Amended) An optical recording method comprising:

controlling a polarization angle of a recording light emitted from a light source, the recording light externally controlled from an optical recording medium to rotate the polarization angle of the recording light;

illuminating the optical recording medium with said recording light; and

forming an optical element on the optical recording medium by the illumination, that acts substantially as a half-wave plate, having an azimuth corresponding to a polarization angle on the optical recording medium,

wherein the azimuth corresponding to a polarization angle on the optical recording medium is multilevel-modulated so that information is recorded on the optical recording medium by the recording light.~~recorded information can be reproduced from the~~

~~optical recording medium so that the polarization angle of a reproducing light is at least twice that of the recording light.~~

26. (~~Three~~ Four Times-Amended) An optical recording method comprising:

controlling a polarization angle of a recording light emitted from a light source, the recording light externally controlled from an optical recording medium to rotate the polarization angle of the recording light;

illuminating the optical recording medium with said recording light; and

forming an optical element on the optical recording medium by the illumination, that acts substantially as a quarter-wave plate, having an azimuth corresponding to a polarization angle on the optical recording medium,

wherein the azimuth corresponding to a polarization angle on the optical recording medium is multilevel-modulated so that information is recorded on the optical recording medium by the recording light.~~recorded information can be reproduced from the optical recording medium so that the polarization angle of a reproducing light is at least twice that of the recording light.~~

30. (Twice Amended) An optical recording apparatus comprising:

a light source that generates recording light;

a spatial optical modulator that controllably rotates a polarization angle of said recording light; and

a focusing optical system that multilevel-modulates an azimuth of an optical recording layer within an optical recording medium by directing~~s~~ the recording light obtained through the spatial optical modulator to ~~an~~ the optical recording medium.

35. (~~Four~~ Five Times-Amended) An optical recording medium, comprising an optical recording layer including an optical recording material having at least one of a polymer or a liquid crystal polymer that stores multilevel information using a light induced

birefringence that acts optically as a half-wave plate, an orientation of an azimuth of birefringence formed by a recording light representing the multilevel information, the recording light externally controlled from the optical recording medium to rotate a polarization angle of the recording light; and

a substrate which sustains the optical recording layer,

wherein the azimuth of birefringence formed by the recording light is multilevel-modulated so that information is recorded on the optical recording medium by the recording light.~~recorded information can be reproduced from the optical recording medium so that the polarization angle of a reproducing light is at least twice that of the recording light.~~

37. (~~Four~~ Five Times-Amended) An optical recording medium, comprising an optical recording layer including an optical recording material having at least one of a polymer or a liquid crystal polymer that stores multilevel information using a light induced birefringence that acts optically as a quarter-wave plate, at orientation of an azimuth of birefringence induced by controllably rotating a polarization angle of a recording light externally from the optical recording medium that represents the multilevel information; and

a substrate which sustains the optical recording layer,

wherein the orientation of the azimuth of birefringence is multilevel-modulated so that information is recorded on the optical recording medium by the recording light.~~recorded information can be reproduced from the optical recording medium so that the polarization angle of a reproducing light is at least twice that of the recording light.~~

39. (~~Four~~ Five Times-Amended) An optical recording medium, comprising an optical recording layer having at least one of a polymer or a liquid crystal polymer in which an azimuth of birefringence induced by controllably rotating a polarization angle of a recording light externally from the optical recording medium is multilevel-modulated and recorded in response to a rotation of a polarization angle of said recording light; and

a substrate which sustains the optical recording layer;

wherein the azimuth of birefringence is multilevel-modulated so that information is recorded on the optical recording medium by the recording light. ~~recorded information can be reproduced from the optical recording medium so that the polarization angle of a reproducing light is at least twice that of the recording light.~~

40. (~~Three~~ Four Times-Amended) An optical reproducing method comprising:

radiating a reproducing light on an optical recording medium in which an azimuth of an optical element that acts substantially as a half-wave plate is multilevel recorded in response to a polarization angle of a recording light that is externally controlled from the optical recording medium to rotate the polarization angle of the recording light; and

determining a polarization angle of the reproducing light transmitted by said optical element,

wherein the reproducing light is directed on the optical recording medium in which an azimuth of the half-wave plate within the optical recording medium has been multilevel-modulated so that recorded information can be reproduced. ~~recorded information can be reproduced from the optical recording medium so that the polarization angle of the reproducing light is at least twice that of the recording light.~~

43. (~~Three~~ Four Times-Amended) An optical reproducing method comprising:

radiating reproducing light on an optical recording medium in which an azimuth of an optical element that acts substantially as quarter-wave plate is multilevel-recorded in response to a polarization angle of a recording light that is externally controlled from the optical recording medium to rotate the polarization angle of the recording light; and

determining a polarization angle reproducing light reflected from said optical element,

wherein the reproducing light is directed on the optical recording medium in which an azimuth of the quarter-wave plate within the optical recording medium has been multilevel-modulated so that recorded information can be reproduced. ~~recorded information can be reproduced from the optical recording medium so that the polarization angle of the reproducing light is at least twice that of the recording light.~~

46. (~~Three~~ Four Times-Amended) An optical reproducing apparatus comprising:

a reproducing light optical system for transmitting reproducing light to an optical recording medium in which an azimuth of an optical element that acts substantially as a half-wave plate is multilevel recorded in response to a polarization angle of a recording light that is externally controlled from the optical recording medium to rotate the polarization angle of the recording light; and

an analyzing unit that detects a polarization angle of reproducing light transmitted by said optical element,

wherein the reproducing light is directed on the optical recording medium in which an azimuth of the half-wave plate within the optical recording medium has been multilevel-modulated so that recorded information can be reproduced. ~~recorded information can be reproduced from the optical recording medium so that the polarization angle of the reproducing light is at least twice that of the recording light.~~

49. (~~Three~~ Four Times-Amended) An optical reproducing apparatus comprising:

a reproducing light optical system for emitting reproducing light toward an optical recording medium in which an azimuth of an optical element that acts substantially as a quarter-wave plate is multilevel recorded in response to a polarization angle of a recording light that is externally controlled from the optical recording medium to rotate the polarization angle of the recording light; and

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an analyzing unit that detects a polarization angle of reproducing light reflected by an optical reflection layer and transmitted by said optical element,

wherein the reproducing light is directed on the optical recording medium in which an azimuth of the quarter-wave plate within the optical recording medium has been multilevel-modulated so that recorded information can be reproduced.~~recorded information can be reproduced from the optical recording medium so that the polarization angle of the reproducing light is at least twice that of the recording light.~~

52. (~~Three~~ Four Times-Amended) An optical recording and reproducing apparatus comprising:

a light source that generates a recording light;

a polarization rotary device that rotates a polarization angle of said recording light;

a focusing optical system that irradiates an optical recording medium with said recording light obtained from said polarization rotary device;

a reproducing light optical system that irradiates said optical recording medium with reproducing light; and

an analyzing unit that detects a polarization angle of reproducing light acted on by said optical recording medium,

wherein the reproducing light is directed onto the optical recording medium after the optical recording medium has been multilevel-modulated so that recorded information can be reproduced.~~recorded information can be reproduced from the optical recording medium so that the polarization angle of the reproducing light is at least twice that of the recording light.~~

53. (~~Three~~ Four Times-Amended) A method for optically recording and reproducing information, comprising:

controlling a polarization angle of a recording light emitted from a light source, the recording light controlled externally from an optical recording medium to rotate the polarization angle of the recording light;

illuminating the optical recording medium with said recording light;

forming an optical element on the optical recording medium by the illumination having an azimuth corresponding to a polarization angle on the optical recording medium;

radiating reproducing light on the optical recording medium; and

determining a polarization angle of reproducing light acted on by said optical element,

wherein the reproducing light is radiated onto the optical recording medium after the azimuth of the optical recording element has been multilevel-modulated so that recorded information can be reproduced.~~recorded information can be reproduced from the optical recording medium so that the polarization angle of the reproducing light is at least twice that of the recording light.~~

54. (~~Three~~ Four Times-Amended) A device for optically recording and reproducing information, comprising:

controlling means for controlling a polarization angle of a recording light emitted from a light source, the recording light controlled externally from an optical recording medium to rotate the polarization angle of the recording light;

forming means for forming an optical element on the optical recording medium by the illumination having an azimuth corresponding to a polarization angle on the optical recording medium;

illumination means for radiating reproducing light on the optical recording medium; and

determining means for determining a polarization angle of reproducing light acted on by said optical element,

wherein the reproducing light is directed onto the optical recording medium after the azimuth corresponding to the polarization angle on the optical element has been multilevel-modulated so that recorded information can be reproduced.~~recorded information can be reproduced from the optical recording medium so that the polarization angle of the reproducing light is at least twice that of the recording light.~~

55. (~~Four~~ Five Times-Amended) An optical recording medium, comprising an optical recording layer having at least one of a polymer or a liquid crystal polymer in which an optical element is formed by a recording light that is externally controlled from the optical recording medium to rotate a polarization angle of the recording light, the optical element having an azimuth of birefringence and acting on reproducing light to adjust a polarization angle of the reproducing light by an amount greater than a difference between a polarization angle of the recording light used to form the optical element and a polarization angle of the reproducing light before the reproducing light is acted on by the optical element; and

a substrate which sustains the optical recording layer,

wherein the reproducing light is directed onto the optical recording medium after the azimuth of birefringence of the optical element has been multilevel-modulated so that recorded information can be reproduced.~~recorded information can be reproduced from the optical recording medium so that the polarization angle of the reproducing light is at least twice that of the recording light.~~